The rate of fusion with the use of the threaded titanium cages is encouraging and is comparable to either posterior or combined anterior and posterior fusion. In addition, interbody fusion is between 30% and 40% less costly than combined anterior and posterior fusion. The device-related complication rate is quite low, particularly when the device is implanted anteriorly. Clinical trials are underway to evaluate the use of fusion cages in the thoracic and cervical spine.

This technology represents a significant step forward in the treatment of low back pain. It is important to recognize, however, that the surgical indications for lumbar spine fusion for low back pain remain unchanged and that the goal is not only a solid fusion but a more functional patient.

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Pelvic Fractures

PELVIC FRACTURES WITH their associated injuries can produce significant short-term mortality, with rates of 10% to 20%. When head injury accompanies a pelvic fracture, the mortality rate can climb to 50%. Pelvic injuries also have significant long-term morbidity, such as late pain and the impaired function of the pelvis for sitting and weight bearing that results from pelvic nonunion, pelvic malunion, and leg-length discrepancy. Current methods to reduce the high mortality and morbidity rates begin with the emergency resuscitation phase and continue into the definitive treatment phase. In the past, nonoperative treatment was often considered the safest option; today, however, with our improved techniques and medical care, operative treatment can lead to reduced morbidity.

An important concept is that *both* anterior and posterior injuries occur in pelvic injuries (with only rare exceptions). Some long-term morbidity is related to the failure to recognize an unstable posterior injury. Frequent use of CT scanning has assisted in locating posterior injuries, but the assessment of pelvic stability can still require the expertise of a traumatologist who frequently treats these injuries. A stable pelvis is one that is able to withstand normal physiologic forces without abnormal deformation, which is determined by the remaining intact bony and ligamentous structures after injury. Radiographic signs of instability include symphysis diastasis more than 2.5 cm; ischial spine or lateral sacrum avulsion fractures; L5 transverse process fractures; sacroiliac translation more than 1 cm; and a sacral fracture gap instead of impaction. When the injury results from high-energy mechanisms—such as motor vehicle accidents or falls from great heights—a high index of suspicion for instability is necessary to avoid complications related to inadequate treatment. When instability is suspected but not obvious, push/pull stress x-ray studies or fluoroscopy can confirm excessive motion at the posterior injury site.

When the mechanism of injury is considered, the pelvis is believed to respond to three primary forces of injury: external rotation, lateral compression, and vertical shear. Each of these forces, depending on the energy of the injury, can lead to stable injuries, to severely unstable injuries, or to injuries that fall anywhere between these categories. Combined forces of injury lead to combined patterns of injury, which also makes the evaluation of specific injuries more difficult.

Pelvic injuries resulting from low-energy mechanisms, such as avulsion fractures or low-height falls in older patients, are generally stable and usually treated symptomatically, whereas pelvic injuries resulting from high-energy trauma are treated according to ATLS protocol. The methods to address major intrapelvic bleeding include orthopedic reduction and stabilization of the pelvic ring; angiographic embolization; and open surgical repair, ligation, or packing. Reducing and stabilizing the pelvic ring with emergent external fixation decreases intrapelvic volume (assisting tamponade), minimizes motion at the fracture site, and assists patient mobility and transport during resuscitation and evaluation.

Angiography localizes bleeding and allows for therapeutic embolization, which can lead to excellent hemodynamic control. Whether external fixation or angiography is done first remains controversial. Either is indicated for persistent hypovolemic shock after fluid and blood replacement. Open surgical repair, ligation, or packing is primarily reserved for patients who do not respond to external fixation and angiographic embolization, and for those who have injuries to large vessels such as the external iliac or common iliac artery.

The orthopedic goal in an emergency setting is common to all physicians: to assist with patient resuscitation. When the patient requires emergency surgery for abdominal bleeding, genitourinary or gastrointestinal injury, or other reasons, the orthopedic surgeon should be involved early to ensure the consideration of emergent stabilization with external fixation, open reduction and internal fixation, and even percutaneous iliosacral screws. When communication is strong among surgical subspecialties, many of these options can be done expeditiously and in conjunction with other procedures. For example, midline abdominal incisions can be quickly extended to the symphysis for plate stabilization of symphyseal injuries.

External fixation can be performed quickly by experienced surgeons and with particular attention to positioning away from the abdomen, if a laporotomy incision is planned. Additional pins and bars or adjustments can be made after the initial resuscitation. When external fixa-

tion is considered, *relative contraindications*—including fractures located at the intended fixator pin insertion sites, most acetabular fractures, and many bilateral or complex fracture patterns—also must be considered. (Before emergent external fixation can occur, the AP pelvis x-ray film must be reviewed to determine if the pelvis is amenable to that treatment.)

A simple anterior fixator can be applied quickly. If applied incorrectly or if over-compressed, however, it can distract a more significant posterior injury. If this occurs, incomplete anterior reduction or supplemental posterior stabilization should be considered. External fixators have been designed to insert into the posterior sacroiliac joint region, which closes pelvic volume posteriorly and anteriorly. They are designed for rapid application during hemodynamic instability, but each requires experience in its application; additionally, they are only temporary stabilizers that should be removed within a few days, to avoid potential complications.

After obtaining adequate hemodynamic stability, the pelvic injury can be further evaluated for definitive management. In addition to the AP pelvis x-ray, radiographic inlet and outlet views and, occasionally, 45-degree oblique views of the pelvis are helpful in operative decisions and planning even when computed tomography (CT) scan results are available. When anterior injuries are identified on plain radiographs in patients with high-energy mechanisms of injury, a CT scan should be performed to determine the extent of the posterior injury.

The general principle for the definitive orthopedic management of pelvic injuries is to restore pelvic ring anatomy. This will provide stability and help to avoid deformity, which can lead to leg-length discrepancy or sitting problems, nonunion, and late instability or pain. Radiographic and physical examination of pelvic stability is necessary to determine whether surgical management is needed. A "stable" pelvic fracture is often amenable to bed rest until walking with support (for instance, using crutches, a walker, or a cane) is comfortable and weight bearing can be tolerated. These fractures must be followed closely with serial clinical and radiogaphic examinations to confirm their stability.

For the mechanically unstable or deformed pelvis, reduction and stabilization is necessary. Open reduction internal fixation is preferred, but the treatment depends on the patient and the injury. Internal, external, and percutaneous fixation techniques (including the best surgical approaches) have evolved over the past two decades and have shown improvements in patient outcomes. Newer techniques, such as percutaneous iliosacral screws, are providing less invasive options to achieve pelvic stability, but they, too, have potential risks.

Although many skilled surgeons could treat the pelvic injuries discussed here, it is important that patients with these injuries are treated at high-level trauma centers with established protocols. Even in the most ideal circumstances, patients who experience severe pelvic injuries continue to have high rates of morbidity and mortality. Decisions of whether to operate, when to operate, and which technique to use should be made by an orthopedic traumatologist trained in the management of severe pelvic injuries.

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The Use of Lasers in Musculoskeletal Disease

LASERS AND RELATED TECHNOLOGIES have recently been introduced for orthopedic surgery and for the treatment of pathologic musculoskeletal conditions. Half a dozen different kinds of lasers are used in surgery. The critical difference between the different kinds is the wavelength of light emitted, which affects both the interaction of the light beam with the tissue and the equipment needed to deliver the light to the target. A CO_2 laser beam is quenched in aqueous solution and requires gas insufflation of joints. Other lasers can use flexible fiber-optic delivery systems that function in saline.

The energy of the laser beam is typically converted to heat, depending on both the wavelength of the light and the magnitude of the light flux. At the highest intensities, tissue is ablated by vaporization. At the lower intensities, collagen can be denatured and reannealled, which results in the shortening and thickening of a section of a ligament, tendon, or capsule.

Lasers were first introduced as cutting instruments for resection of meniscal tears. In recent years, with the introduction of the holmium:YAG laser, near-infrared light energy has been used for arthroscopic resection of pathologic tissues. Laser-induced capsular shift procedures are now commonly performed for uni- and multidirectional instability of the shoulder, especially in high-level athletes. Less expensive thermal devices will most likely replace the laser for the thermal capsular shift procedures. In the field of spine surgery, lasers are being used in Europe for endoscopic resection of degenerative disks. Lasers have also been used to vaporize methyl methacrylate cement in hip revision surgery, but the toxicity of vaporization products has precluded widespread acceptance of this technique.

Recent reports have suggested a correlation between cases of osteonecrosis and arthroscopic laser use. Multiple retrospective reviews have presented conflicting results. Studies in pigs demonstrated the production of photo-acoustic pressure waves in subchondral bone, causing extensive subchondral hemorrhage when